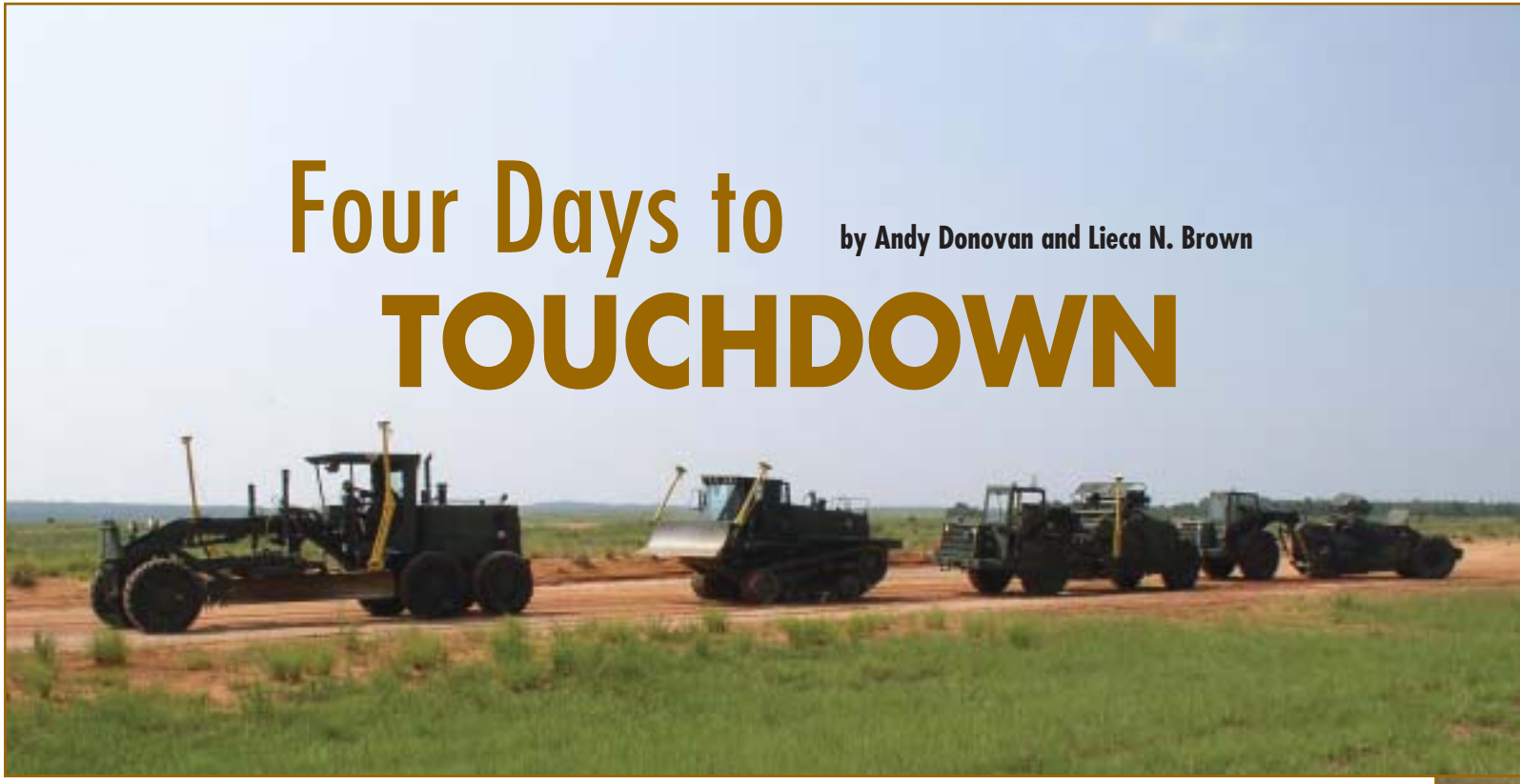
Four Days to TOUCHDOWN

by Andy Donovan and Lieca N. Brown



How the U.S. Army built an aircraft parking apron in record time.

At a minute's notice, the minutemen of the American Revolution were armed and prepared to fight the British regulars. The philosophy behind the minutemen still exists today. Many tasks undertaken by today's U.S. Army require an expeditious approach.

One of the greatest challenges to the U.S. Army's Rapid Deployment concept is how to get large amounts of equipment on the ground in a short period of time. Add to this challenge the reality that many of the existing airfields in the world are "undersized, under-strength or severely deteriorated,"[1] and the call to the current military engineer and construction units becomes a greater challenge. To meet the goal of rapid deployment as well as improve on the Army's airfields, the U.S. Army Corps of Engineers, Engineer Research & Development Center (ERDC) spearheaded the creation of the Joint Rapid Airfield Construction (JRAC) mission to "Deploy anytime, anywhere."

Coordinating the necessary equipment to build an aircraft's parking apron (the area in front of or next to the terminal or hangars of an airport) seamlessly, precisely and in record time was a task that had yet to be accomplished—until last summer. A group of soldiers in Ft. Bragg, North Carolina, assessed and selected a site, and created a parking apron for military-use aircraft in a mere 96 hours. What's more, the project was completed in accordance with precise measurement and environmental requirements. The challenge was heightened by the inexperience of several military personnel in surveying and construction practices. "The mission of executing the project under time and environmental constraints was like choreographing a large musical production that no one had seen before," says Joe McNamara, vice president and machine control specialist with Spectra Integrated Systems of Charlotte,

As part of the JRAC effort, a group of soldiers in Ft. Bragg, North Carolina, assessed and selected a site for an instant airport, created a parking apron for military-use aircraft in a

North Carolina (www.spectra-is.com), the company called upon for survey and machine control training. The accomplishment of this task has set the stage for future tasks of equal measure. How did they do it? Take a look.

The Conditions of Rapid Deployment

The U.S. Army uses the 150,000-lb Lockheed Martin C130 and the Boeing C17 (which can weigh as much as 500,000 lbs) as its primary modes of air transportation. Both vehicles are short take-off and landing aircrafts that can carry large loads long distances with delivery close to the ground, and both are certified to land on dirt runways, which oftentimes is the only way to gain access into a remote area. Remote dirt runways, however, have less than favorable conditions: they are often short, unlevel and very dusty. They also don't offer taxiways and tarmacs for servicing aircraft. These challenging conditions during takeoffs and landings led members of the Army's 412th Engineering Command and the XVIII Airborne Corps in Vicksburg, Mississippi, to create a state-of-the-art parking apron applying rapid deployment. After diligent preparation, the execution of the task was demonstrated at Ft. Bragg, North Carolina, in July of 2004.

A Different Kind of Boot Camp

Logistics of the JRAC mission include getting soldiers into an area quickly to assess the conditions of the site for building the parking apron. Once assessment reveals acceptance of the site for airfield use, the soldiers are tasked with applying the necessary skills to build that airfield. The goal is to do it all within 96 hours total. Building an efficient parking apron in such a short time and in a hostile environment is demanding enough, but applying the full set of logistics of the rapid deployment concept creates a trial of its own. For two years, preparations for the project were scrutinized, tested and tweaked accordingly.

Technology—and savvy soldiers—offered the solutions. The Corps and the 412th had help from a number of specialists associated with the technologies chosen to accomplish the JRAC mission. Spectra Integrated Systems trained six soldiers who had limited total station or GPS experience on the surveying equipment in a mere four and a half days, and trained eight soldiers who had no experience on the GPS machine operation end in just two and a half days. Spectra used a double-teamed approach to ready the soldiers for their task.

"Basically we trained them to do a GPS site calibration and set conventional control at the same time," McNamara says. "To meet the timeline, a two team approach was used with one team at the total station/GPS base station, and one team with the prism and GPS rover. The rover team set mon-

mere 96 hours and completed the project in accordance with precise measurement and environmental requirements.

uments around the perimeter of the site while the base team set up the total station and GPS base. Once a local coordinate system was established off two monuments by the base team, the rover team occupied each control point to take a GPS reading for a site calibration while the base team shot the prism on the GPS pole to get local coordinates.

"The training for the machine operators was different from [our] normal [training] due to the timeline. We showed the operators how the system would fill in the color [on] the plans in the cab as they graded. The graphics showed very clearly how deep to go for stripping topsoil. As they cut across the apron, the plan view screen would go from blue to green to show they were at grade, and red if they went below grade. This process was also used to cut from one apron and to fill on the other apron."

Credit for the efficient training is due both to the professionals at Spectra Integrated Systems and to the soldiers. "The one great thing about these soldiers is that they have an 'I can do anything' attitude," says Travis Mann, who oversaw the construction technology aspects of the project. "They're pretty receptive to learning [the technology]. The soldiers had a lot of good questions, and the trainers were great. That certainly made a difference on how fast they could pick it up."

"Much of the success [for the demonstration] goes to the soldiers who actually performed the tasks. That was a big point of skepticism of this project," says Dr. Gary Anderton, program manager for the project, citing the training curve for the inexperienced soldiers. "We were sure to package our technologies in the most user-friendly and easy way."

Anderton says that soldiers move on to other projects on a frequent basis—about every year or two. Thus, the engineers wanted to create a very detailed and easy-to-understand, quick-training package for the surveyors and equipment operators.

Assessing the Blackened Site

The JRAC test project was begun at 12 a.m. on a Monday to evaluate how well the sight-intensive task could be accomplished in the dark, and to prove that the task members could work in the cover of night for safety purposes. All backlights of the instruments were turned off and any flashing lights like power indicators were taped over. The surveying team used night vision goggles and infrared glow sticks to mark control points. Also onsite was a modified Bobcat (www.bobcat.com) Toolcat 5600 utility vehicle named RAVEN (for Rapid Assessment Vehicle Engineer), equipped with a Real-Time Kinematic GPS survey system, two Panasonic Tough Book laptop computers, and a rapid soils assessment kit containing a microwave, small sieve tower, sample collection tools and an electronic balance. The RAVEN was used to conduct a continuous topo of the site by taking shots every 3 meters over approximately 25 acres and a point-to-point topo of the edge of taxiway. In dark surroundings and amid tall grass and sandy soil, members of the Corps, the Engineer Brigade and the 412th Command collected data using two Trimble (www.trimble.com) 5800 GPS rovers and one Trimble 750 base, one rover on the RAVEN and the other on a rod measuring areas not accessible to the RAVEN. The resulting map denoted the area to be graded. The establishment of nine control points, a simultaneous GPS site calibration and the collection of soil samples for possible apron locations were completed in a blackout environment. By 6 a.m., the existing surface data was turned over to the design team.

Grading the Apron

Using Trimble's Terramodel software, the design engineers layed apron templates on the topographic map to design two tarmacs with surrounding drainage in less than four hours. By 10 a.m. Monday the design was complete and ready to be utilized by Trimble SiteVision systems on a Caterpillar (www.cat.com) 130G motorgrader, a Caterpillar Deuce (Deployable Universal Combat Earthmover) and a Caterpillar

Autonomous Advantages

The RAVEN utility vehicle can be used in three modes: by a user in the cab, through remote control use and through autonomous mode. If a site is deemed too risky for soldiers to approach, the RAVEN can be pre-programmed to conduct a topo survey using GPS coordinates. This includes directions for paths to follow, instructions to stop at given intervals and, if equipped, guidelines to assess the soil strength.

"The controls were installed to see if we could meet the premise of getting a topo survey done where there is a chemical biohazard, or if the line is too close for personnel," says Dr. Anderton. "With the advent of chemical biohazards, there is more emphasis on robotics and defense mechanisms that aren't standard. We want to remove any life-threatening situations."

615 paddlewheel scraper. For GPS-guided machine control, the Trimble SiteVision system puts design surfaces, grades and alignments inside the cab for the operator to perform earthwork in a stakeless environment.

With no stakes in the ground for grade or guidance, the machines equipped with SiteVision went to work grading one of the tarmacs. In 12 hours the first tarmac was graded and work had started on the second. Both tarmacs were built by Tuesday evening. Finish grade and the surrounding drainage were finalized through Wednesday, when the first tarmac was complete and ready to receive the aircraft. The clock was ticking for the completion of the second tarmac; the C130 was scheduled to land at 10 a.m. on Thursday morning. At 7 a.m. Thursday, the second tarmac was complete.

Testing the Soil

Once the earthmoving was completed and the grading activity began, extensive soils testing also took place to ensure the proper moisture and soils contents for the site. This was critical to the success of the project; the last thing all involved wanted to see was a C130 sink into the dirt and become immobilized. A soil pulver mixer followed the application of low-dosage rapid-curing soil stabilizers, trailed by a compactor. To help ensure against loose surfaces, a polymer was applied to the finished tarmac surface in order to test it for solidity and resiliency. At the same time, part of the tarmac was covered by fiberglass panels that interlocked to form a hard platform.

She's Coming in For A Landing

As the C130 approached the apron, everyone involved with the project stood motionless. The first test was a dust retardant placed on a small part of the taxiway. The C130 landed and taxied toward the tarmac. Dust was flying, causing a cloud that engulfed the rear of the C130. As the aircraft rolled over the treated area, the dust stopped. "The soils workers cheered, and the officers and administrators from the Pentagon were visibly impressed," McNamara says. Next, the C130 pulled onto the treated tarmac. It rolled into the tarmac, made a turn and parked. As everyone approached the craft it was obvious the polymer treatment had worked. No tracks were visible in the soil. Where the C130 sat the tires did not sink into the surface. The project was a total success! Two years of preparation culminated in proving that the trained use of advanced technology never used by the Army before could deliver a better product in a fraction of the time. The mission proved that the JRAC concept was not only smart but achievable. Now that it has been successfully demonstrated, the project turns to preparing for a similar demonstration for the C-17 scheduled for 2007. "[The project] has been kind of an azimuth check, as this is a midpoint," Mann says. "Our [next] goal is to do this with the C17."

For that, other circumstantial logistics lie ahead. According to Anderton, the C17-capable airfield will require a deeper soil foundation to accommodate the heavier aircraft, as the stresses are greater. The team will also need to utilize multilift stabilizers and decrease their time limits. The construction portion, he says, is "pretty much nailed down," and the technology is selected. The location for the C17 demonstration will be selected in time for the demonstration. But the soldiers and adminstrators are already confident of success.

"It [the C130 demonstration] seemed like a 'pie in the sky' idea in the beginning," Anderton says. "Deciding where to go, the design concept, stabilization, matting systems, how to construct, reducing the safety factors… We proved that cutting all of these corners and compressing that timeline is doable. We proved the concept and now we need to refine the whole package [for the C17 demonstration]." After the second demonstration, the team will then be able to write the specifications for each tool, build other kits, specify soil stabilizers needed for inventory, specify materials and record stock numbers, and create a training piece.

"We certainly proved that what we're doing is doable, to put it simply," Anderton says. And by 2010, any agency of the ERDC should be capable of enforcing the JRAC concept. These missions will enhance the U.S. Army's actions immensely and confirm a new revolution of minutemen. **SP**

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[1] U.S. Army Corps of Engineers, Engineer Research & Development Center, Joint Rapid Airfield Construction Video, 2004.